E 3510-22-P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[RTID 0648-XB423]

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to U.S. Navy 2022 Ice Exercise Activities in the Arctic Ocean

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments on proposed authorization and possible renewal.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to Ice Exercise 2022 (ICEX22) north of Prudhoe Bay, Alaska. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an incidental harassment authorization (IHA) to incidentally take marine mammals during the specified activities. NMFS is also requesting comments on a possible one-time, one-year renewal that could be issued under certain circumstances and if all requirements are met, as described in **Request for Public Comments** at the end of this notice. NMFS will consider public comments prior to making any final decision on the issuance of the requested MMPA authorization and agency responses will be summarized in the final notice of our decision. The Navy's activities are considered military readiness activities pursuant to the MMPA, as amended by the National Defense Authorization Act for Fiscal Year 2004 (2004 NDAA).

DATES: Comments and information must be received no later than [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, and should be submitted via email to *ITP.Davis@noaa.gov*.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. Comments, including all attachments, must not exceed a 25-megabyte file size. All comments received are a part of the public record and will generally be posted online at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities* without change. All personal identifying information (*e.g.*, name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Leah Davis, Office of Protected Resources, NMFS, (301) 427-8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

The MMPA prohibits the "take" of marine mammals, with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are proposed or, if the taking is limited to harassment, a notice of a proposed incidental harassment authorization is provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the species or stocks for taking for certain subsistence uses (referred to in shorthand as "mitigation"); and requirements pertaining to the mitigation, monitoring, and reporting of the takings are set forth.

The 2004 NDAA (Pub. L. 108–136) removed the "small numbers" and "specified geographical region" limitations indicated above and amended the definition of "harassment" as applied to a "military readiness activity." The activity for which incidental take of marine mammals is being requested addressed here qualifies as a military readiness activity. The definitions of all applicable MMPA statutory terms cited above are included in the relevant sections below.

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq*.) and NOAA Administrative Order (NAO) 216-6A, NMFS must review our proposed action (*i.e.*, the issuance of an IHA) with respect to potential impacts on the human environment. Accordingly, NMFS plans to adopt the Navy's Environmental Assessment (EA), provided our independent evaluation of the document finds that it includes adequate information analyzing the effects on the human environment of issuing the IHA. The Navy's EA was made available for public comment at *https://www.nepa.navy.mil/icex/* for 30 days beginning November 24, 2021.

We will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the IHA request.

Summary of Request

On August 26, 2021, NMFS received a request from the Navy for an IHA to take marine mammals incidental to submarine training and testing activities including establishment of a tracking range on an ice floe in the Arctic Ocean, north of Prudhoe Bay, Alaska. The application was deemed adequate and complete on November 4, 2021. The Navy's request is for take of a small number of ringed seals (*Pusa hispida*) by Level B harassment only. Neither the Navy nor NMFS expects serious injury or mortality to result from this activity and, therefore, an IHA is appropriate.

NMFS previously issued IHAs to the Navy for similar activities (83 FR 6522; February 14, 2018, 85 FR 6518; February 5, 2020). The Navy complied with all the requirements (*e.g.*, mitigation, monitoring, and reporting) of the previous IHAs and information regarding their monitoring results may be found below, in the **Estimated Take** section.

Description of Proposed Activity

Overview

The Navy proposes to conduct submarine training and testing activities, which includes the establishment of a tracking range and temporary ice camp, and research in the Arctic Ocean for six weeks beginning in February 2022. Submarine active acoustic transmissions may result in occurrence of Level B harassment, including temporary hearing impairment (temporary threshold shift (TTS)) and behavioral harassment, of ringed seals.

Dates and Duration

The specified activities would occur over approximately a six-week period between February and April 2022, including deployment and demobilization of the ice camp. The submarine training and testing activities would occur over approximately four weeks during the six-week period. The proposed IHA would be effective from February 1, 2022 through April 30, 2022.

Geographic Region

The ice camp would be established approximately 100-200 nautical miles (nmi) north of Prudhoe Bay, Alaska. The exact location of the camp cannot be identified ahead of time as required conditions (*e.g.*, ice cover) cannot be forecasted until exercises are expected to commence. Prior to the establishment of the ice camp, reconnaissance flights would be conducted to locate suitable ice conditions. The reconnaissance flights would cover an area of approximately 70,374 square kilometers (km^2). The actual ice camp would be no more than 1.6 kilometers (km) in diameter (approximately 2 km^2 in area). The vast majority of submarine training and testing would occur near the ice camp, however some submarine training and testing may occur throughout the deep Arctic Ocean basin near the North Pole within the larger Navy Activity Study Area. Figure 1 shows the locations of the Navy Activity Study Area and Ice Camp Study Area, collectively referred to in this document as the “ICEX22 Study Area”.

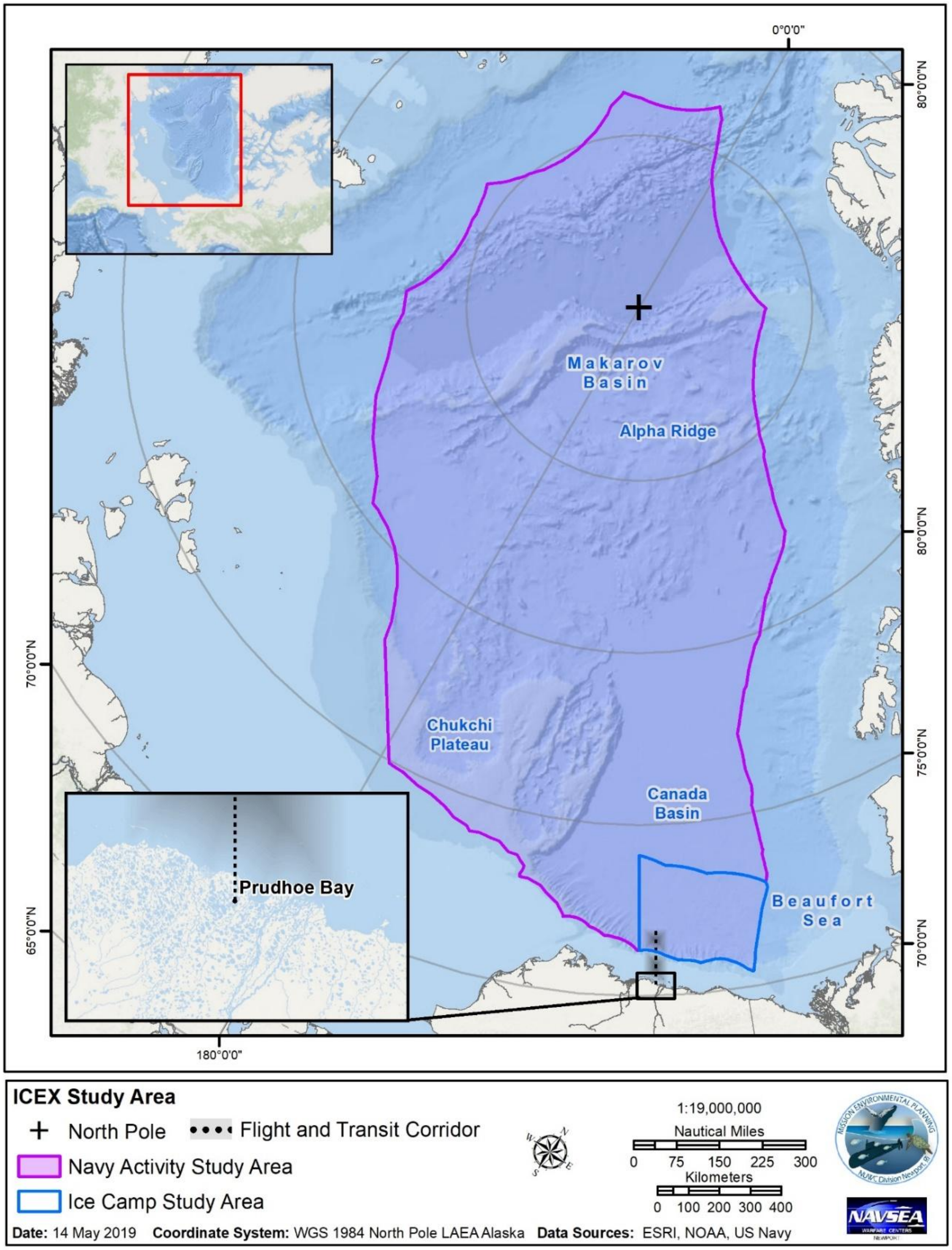

Figure 1—ICEX22 Study Area in the Arctic Ocean

Detailed Description of Specific Activity

The Navy proposes to conduct submarine training and testing activities, which includes the establishment of a tracking range and temporary ice camp, and research in the Arctic Ocean for six weeks beginning in February 2022. The activity proposed for 2022 and that is being evaluated for this proposed IHA—ICEX22—is part of a regular cycle of recurring training and testing activities that the Navy proposes to conduct in the Arctic. Under the Navy's proposed cycle, submarine and tracking range activities would be conducted biennially, but a temporary ice camp would be established annually, either in the ice camp study area (Figure 1) or on a frozen lake in Deadhorse, Alaska. Some of the submarine training and testing may occur throughout the deep Arctic Ocean basin near the North Pole, within the Navy Activity Study Area (Figure 1). The temporary ice camps that would be constructed during years in which submarine training and testing is not conducted (referred to as "beta camps") would support testing and evaluation of Arctic equipment, but would involve fewer personnel and be shorter in duration than camps constructed during years in which submarine training and testing is conducted. Activities that the Navy proposes to conduct after ICEX22, including the construction of the beta camps, are outside of the scope of this proposed IHA, and therefore, are not discussed further in this document. Additional information about the Navy's proposed training and testing activities in the Arctic is available in the Navy's 2021 Draft Environmental Assessment/Overseas Environmental Assessment For the Ice Exercise Program, available at *https://www.nepa.navy.mil/icex/*. Only activities which may occur during ICEX22 are discussed in this section.

Ice Camp

ICEX22 includes the deployment of a temporary camp situated on an ice floe. Reconnaissance flights to search for suitable ice conditions for the ice camp would depart from the public airport in Deadhorse, Alaska. The camp generally would consist of a command hut, dining hut, sleeping quarters, a powerhouse, runway, and helipad. The number of structures and tents would range from 15-20, and each tent is typically 2 meters (m) by 6 m in size. The completed ice camp, including runway, would be approximately 1.6 km in diameter. Support equipment for the ice camp would include snowmobiles, gas-powered augers and saws (for boring holes through ice), and diesel generators. All ice camp materials, fuel, and food would be transported from Prudhoe Bay, Alaska, and delivered by air-drop from military transport aircraft (*e.g.*, C-17 and C-130), or by landing at the ice camp runway (*e.g.*, small twin-engine aircraft and military and commercial helicopters).

A portable tracking range for submarine training and testing would be installed in the vicinity of the ice camp. Ten hydrophones, located on the ice and extending to 30 m below the ice, would be deployed by drilling or melting holes in the ice and lowering the cable down into the water column. Four hydrophones would be physically connected to the command hut via cables while the others would transmit data via radio frequencies. Additionally, tracking pingers would be configured aboard each submarine to continuously monitor the location of the submarines. Acoustic communications with the submarines would be used to coordinate the training and research schedule with the submarines. An underwater telephone would be used as a backup to the acoustic communications.

Additional information about the ICEX22 ice camp is located in the 2021 Draft Environmental Assessment/Overseas Environmental Assessment For the Ice Exercise Program. We have carefully reviewed this information and determined that activities associated with the ICEX22 ice camp, including *de minimis* acoustic communications, would not result in incidental take of marine mammals.

Submarine Activities

Submarine activities associated with ICEX22 generally would entail safety maneuvers, active sonar use, and exercise weapon use. The safety maneuvers and sonar use are similar to submarine activities conducted in other undersea environments and are being conducted in the Arctic to test their performance in a cold environment. The Navy anticipates the use of no more than 20 exercise weapons during ICEX22. The exercise weapons are inert (*i.e.*, no explosives), and will be recovered by divers, who enter the water through melted holes, approximately 3-4 feet wide. Submarine training and testing involves active acoustic transmissions, which have the potential to harass marine mammals. The Navy categorizes acoustic sources into "bins" based on frequency, source level, and mode of usage (U.S. Department of the Navy, 2013). The acoustic transmissions associated with submarine training fall within bins HF1 (hull-mounted submarine sonars that produce high-frequency [greater than 10 kHz but less than 200 kHz] signals), M3 (mid-frequency [1-10 kHz] acoustic modems greater than 190 dB re 1 μPa), and TORP2 (heavyweight torpedo), as defined in the Navy's Phase III at-sea environmental documentation (see Section 3.0.3.3.1, *Acoustic Stressors*, of the 2018 AFTT Final Environmental Impact Statement/Overseas Environmental Impact Statement, available at *https://www.nepa.navy.mil/AFTT-Phase-III/*). The specifics of ICEX22 submarine acoustic sources are classified, including the parameters associated with the designated bins. Details of source use for submarine training are also classified. Any ICEX-specific acoustic sources not captured under one of the at-sea bins were modeled using source-specific parameters.

Aspects of submarine training and testing activities other than active acoustic transmissions are fully analyzed within the 2021 Draft Environmental Assessment/Overseas Environmental Assessment for the Ice Exercise Program. We have carefully reviewed and discussed with the Navy these other aspects, such as vessel use and the firing of inert exercise weapons, and determined that aspects of submarine training and testing other than active acoustic transmissions would not result in take of marine mammals. These other aspects are therefore not discussed further, with the exception of potential vessel strike or exercise weapon strike, which are discussed in the **Potential Effects of Specified Activities on Marine Mammals and Their Habitat** section.

Research Activities

Personnel and equipment proficiency testing and multiple research and development activities would be conducted as part of ICEX22. In-water device data collection and unmanned underwater vehicle testing involve active acoustic transmissions, which have the potential to harass marine mammals; however, the acoustic transmissions that would be used in ICEX22 for research activities are *de minimis.* The Navy has defined *de minimis* sources as having the following parameters: low source levels, narrow beams, downward directed transmission, short pulse lengths, frequencies above (outside) known marine mammal hearing ranges, or some combination of these factors (U.S. Department of the Navy, 2013). NMFS reviewed the Navy's analysis and conclusions on *de minimis* sources and finds them complete and supportable. Additional information about ICEX22 research activities is located in Table 2-1 of the 2021 Draft Environmental Assessment/Overseas Environmental Assessment For the Ice Exercise Program, and elsewhere in that document. We have carefully reviewed this information and determined that use of acoustic transmissions during research activities associated with ICEX22 would not result in incidental take of marine mammals. The possibility of vessel strikes caused by use of unmanned underwater vehicles during ICEX22 is discussed in the Potential Effects of Vessel Strike subsection within the **Potential Effects of Specified Activities on Marine Mammals and Their Habitat** section.

Proposed mitigation, monitoring, and reporting measures are described in detail later in this document (please see **Proposed Mitigation** and **Proposed Monitoring and Reporting**).

Description of Marine Mammals in the Area of Specified Activities

Sections 3 and 4 of the application summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history of the potentially affected species. Additional information regarding population trends and threats may be found in NMFS's Stock Assessment Reports (SARs; *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*) and more general information about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS's website (*https://www.fisheries.noaa.gov/find-species)*.

Table 1 lists all species or stocks for which take is expected and proposed to be authorized, and summarizes information related to the population or stock, including regulatory status under the MMPA and the Endangered Species Act (ESA; 16 U.S.C. 1531 *et seq*.) and potential biological removal (PBR), where known. For taxonomy, we follow Committee on Taxonomy (2021). PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (as described in NMFS's SARs). While no serious injury or mortality is anticipated or authorized here, PBR and annual serious injury and mortality from anthropogenic sources are included in Table 1 as gross indicators of the status of the species and other threats.

Marine mammal abundance estimates represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS's stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS's U.S. Alaska SARs (Muto *et al.* 2021). All values presented in Table 1 are the most recent available at the time of publication and are available in the 2020 Alaska SAR (Muto *et al.* 2021) and draft 2021 Alaska SAR (available online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports*).

Table 1—Species That Spatially Co-Occur With the Activity to the Degree That Take Is Reasonably Likely To Occur

Common name	Scientific name	Stock	ESA/MMPA status; Strategic (Y/N)[1]	Stock abundance (CV; N_{min}; most recent abundance survey)[2]	PBR	Annual M/SI[3]
Family Phocidae (earless seals)						
Ringed seal	*Pusa hispida*	Arctic	T/D;Y	171,418[4,5], (N/A, 158,507[4,5]; 2013)	4,755[6]	6,459[7]

1 - ESA status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.
2- NMFS marine mammal stock assessment reports online at: *https://www.fisheries.noaa.gov/national/ marine-mammal-protection/marine-mammal-stock-assessments*. CV is coefficient of variation; Nmin is the minimum estimate of stock abundance. In some cases, CV is not applicable.
3 – This value, found in NMFS's SARs, represents annual levels of human-caused mortality (M) plus serious injury (SI) from all sources combined (*e.g.*, commercial fisheries, ship strike).
4- These estimates reflect the Bering Sea population only, as reliable abundance estimates for the Chukchi Sea and Beaufort Sea are not available.
5- This is expected to be an underestimate of ringed seals in the Bering Sea, as the estimate was not adjusted for seals in the water at the time of the surveys, nor does it include ringed seals in the shorefast ice zone.
6- The PBR value for this stock is based on a partial stock abundance estimate, and is therefore an underestimate for the full stock.
7- The majority of the M/SI for this stock (6,454 of 6,459 animals) is a result of the Alaska Native subsistence harvest. While M/SI appears to exceed PBR, given that the reported PBR is based on a partial stock abundance estimate, and is therefore, an underestimate for the full stock, M/SI likely does not exceed PBR.

As indicated in Table 1, ringed seals (with one managed stock) temporally and spatially co-occur with the activity to the degree that take is reasonably likely to occur, and we have proposed authorizing it. While beluga whales (*Delphinapterus leucas*), gray whales (*Eschrichtius robustus*), bowhead whales (*Balaena mysticetus*), and spotted seals (*Phoca largha*), may occur in the ICEX22 Study Area, the temporal and/or spatial occurrence is such that take is not expected to occur, and they are not discussed further beyond the explanation provided here. Bowhead whales are unlikely to occur in the ICEX22 Study Area between February and April, as they spend winter (December to March) in the northern Bering Sea and southern Chukchi Sea, and migrate north through the Chukchi Sea and Beaufort Sea during April and May (Muto *et al.* 2021). On their spring migration, the earliest that bowhead whales reach Point Hope in the Chukchi Sea, well south of Point Barrow, is late March to mid-April (Braham *et al*. 1980). Although the ice camp location is not known with certainty, the distance between Point Barrow and the closest edge of the Ice Camp Study Area is over 200 km. The distance between Point Barrow and the closest edge of the Navy Activity Study Area is over 50 km, and the distance between Point Barrow and Point Hope is an additional 525 km (straight line distance); accordingly, bowhead whales are unlikely to occur in the ICEX22 Study Area before ICEX22 activities conclude. Beluga whales follow a migration pattern similar to bowhead whales. They typically overwinter in the Bering Sea and migrate north during the spring to the eastern Beaufort Sea where they spend the summer and early fall months (Muto *et al.* 2021). Though the beluga whale migratory path crosses through the ICEX22 Study Area, they are unlikely to occur in the ICEX 22 Study Area between February and April. Gray whales feed primarily in the Beaufort Sea, Chukchi Sea, and Northwestern Bering Sea during the summer and fall, but migrate south to winter in Baja California lagoons (Muto *et al.* 2020). Typically, northward migrating gray whales do not reach the Bering Sea before May or June (Frost and Karpovich 2008), after the ICEX22 activities would occur, and several hundred kilometers south of the ICEX22 Study Area. Further, gray whales are primarily bottom feeders (Swartz *et al*. 2006) in water less than 60 m deep (Pike 1962). Therefore, on the rare occasion that a gray whale does overwinter in the Beaufort Sea (Stafford *et al*. 2007), we would expect an overwintering individual to remain in shallow water over the continental shelf where it could feed. Therefore, gray whales are not expected to occur in the ICEX22 Study Area during the ICEX22 activity period. Spotted seals may also occur in the ICEX22 Study Area during summer and fall, but they are not expected to occur in the ICEX22 Study Area during the ICEX22 timeframe (Muto *et al.* 2020).

Further, while the Navy requested take of bearded seals (*Erignathus barbatus*), which do occur in the ICEX22 Study Area during the project timeframe, NMFS does not expect that bearded seals would occur in the areas near the ice camp or where submarine activities involving active acoustics would occur, and therefore incidental take is not anticipated to occur and has not been proposed for authorization. Bearded seals are not discussed further beyond the explanation provided here. The Navy anticipates that the ice camp would be established 100-200 nmi (185-370 km) north of Prudhoe Bay in water depths of 800 m or more, and also that submarine training and testing activities would occur in water depths of 800 m or more. Although bearded seals occur 20 to 100 nmi (37 to 185 km) offshore during spring (Simpkins *et al.* 2003, Bengtson *et al.* 2005), they feed heavily on benthic organisms (Hamilton *et al*. 2018; Hjelset *et al.* 1999; Fedoseev 1965), and during winter bearded seals are expected to select habitats where food is abundant and easily accessible to minimize the energy required to forage and maximize energy reserves in preparation for whelping, lactation, mating, and molting. Bearded seals are not known to dive as deep as 800 m to forage (Boveng and Cameron, 2013; Cameron and Boveng 2009; Cameron *et al*. 2010; Gjertz *et al*. 2000; Kovacs 2002) and it is highly unlikely that they would occur near the ice camp or where the submarine activities would be conducted.

In addition, the polar bear (*Ursus maritimus*) may be found in the ICEX22 Study Area. However, polar bears are managed by the U.S. Fish and Wildlife Service and are not considered further in this document.

Ringed Seal

Ringed seals are the most common pinniped in the ICEX22 Study Area and have wide distribution in seasonally and permanently ice-covered waters of the Northern Hemisphere (North Atlantic Marine Mammal Commission 2004), though the status of the Arctic stock of ringed seals is unknown (Muto *et al.* 2020). Throughout their range, ringed seals have an affinity for ice-covered waters and are well adapted to occupying both shore-fast and pack ice (Kelly 1988c). Ringed seals can be found further offshore than other pinnipeds since they can maintain breathing holes in ice thickness greater than 2 m (Smith and Stirling 1975). Breathing holes are maintained by ringed seals' sharp teeth and claws on their fore flippers. They remain in contact with ice most of the year and use it as a platform for molting in late spring to early summer, for pupping and nursing in late winter to early spring, and for resting at other times of the year (Muto *et al.* 2020).

Ringed seals have at least two distinct types of subnivean lairs: haul-out lairs and birthing lairs (Smith and Stirling 1975). Haul-out lairs are typically single-chambered and offer protection from predators and cold weather. Birthing lairs are larger, multi-chambered areas that are used for pupping in addition to protection from predators. Ringed seal populations pup on both land-fast ice as well as stable pack ice. Lentfer (1972) found that ringed seals north of Barrow, Alaska (which would be west of the ice camp), build their subnivean lairs on the pack ice near pressure ridges. They are also assumed to occur within the sea ice in the proposed ice camp area. Ringed seals excavate subnivean lairs in drifts over their breathing holes in the ice, in which they rest, give birth, and nurse their pups for 5–9 weeks during late winter and spring (Chapskii 1940;

McLaren 1958; Smith and Stirling 1975). Snow depths of at least 50–65 centimeters (cm) are required for functional birth lairs (Kelly 1988b; Lydersen 1998; Lydersen and Gjertz 1986; Smith and Stirling 1975), and such depths typically occur only where 20–30 cm or more of snow has accumulated on flat ice and then drifted along pressure ridges or ice hummocks (Hammill 2008; Lydersen *et al.* 1990; Lydersen and Ryg 1991; Smith and Lydersen 1991). Ringed seal birthing season typically begins in March, but the majority of births occur in early April. About a month after parturition, mating begins in late April and early May.

In Alaskan waters, during winter and early spring when sea ice is at its maximal extent, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort Seas (Frost 1985; Kelly 1988c), including in the ICEX22 Study Area. Passive acoustic monitoring (PAM) of ringed seals from a high-frequency recording package deployed at a depth of 240 m in the Chukchi Sea, 120 km north-northwest of Barrow, Alaska, detected ringed seals in the area between mid- December and late May over a four year study (Jones *et al.* 2014). With the onset of the fall freeze, ringed seal movements become increasingly restricted and seals will either move west and south with the advancing ice pack, with many seals dispersing throughout the Chukchi and Bering Seas, or remain in the Beaufort Sea (Crawford *et al.* 2012; Frost and Lowry 1984; Harwood *et al.* 2012). Kelly *et al.* (2010a) tracked home ranges for ringed seals in the subnivean period (using shorefast ice); the size of the home ranges varied from less than 1 km^2 up to 27.9 km^2 (median of 0.62 km^2 for adult males and 0.65 km^2 for adult females). Most (94 percent) of the home ranges were less than 3 km^2 during the subnivean period (Kelly *et al.* 2010a). Near large polynyas, ringed seals maintain ranges up to 7,000 km^2 during winter and 2,100 km^2 during spring (Born *et al.* 2004). Some adult ringed seals return to the same small home ranges they occupied during the previous winter (Kelly *et al.* 2010a). The size of winter home ranges can vary by up to a factor of 10 depending on the amount of fast ice; seal movements were more restricted during winters with extensive fast ice, and were much less restricted where fast ice did not form at high levels (Harwood *et al.* 2015). Ringed seals may occur within the ICEX22 Study Area throughout the year and during the proposed specified activities.

Critical Habitat

On January 8, 2021, NMFS published a revised proposed rule for the Designation of Critical Habitat for the Arctic Subspecies of the Ringed Seal (86 FR 1452). This proposed rule revises NMFS' December 9, 2014, proposed designation of critical habitat for the Arctic subspecies of the ringed seal under the ESA. NMFS identified the physical and biological features essential to the conservation of the species: (1) Snow-covered sea ice habitat suitable for the formation and maintenance of subnivean birth lairs used for sheltering pups during whelping and nursing, which is defined as areas of seasonal landfast (shorefast) ice and dense, stable pack ice, excluding any bottom-fast ice extending seaward from the coastline (typically in waters less than 2 m deep), that have undergone deformation and contain snowdrifts of sufficient depth, typically at least 54 cm deep; (2) Sea ice habitat suitable as a platform for basking and molting, which is defined as areas containing sea ice of 15 percent or more concentration, excluding any bottom-fast ice extending seaward from the coastline (typically in waters less than 2 m deep); and (3) Primary prey resources to support Arctic ringed seals, which are defined to be Arctic cod, saffron cod, shrimps, and amphipods. The revised proposed critical habitat designation comprises a specific area of marine habitat in the Bering, Chukchi, and Beaufort seas, extending from mean lower low water to an offshore limit within the U.S. Exclusive Economic Zone, including a portion of the ICEX22 Study Area (86 FR 1452; January 8, 2021). See the proposed ESA critical habitat rule for additional detail and a map of the proposed area.

The proposed ice camp study area was excluded from the proposed ringed seal critical habitat because the benefits of exclusion due to national security impacts outweighed the benefits of inclusion of this area (86 FR 1452; March 9, 2021). However, as stated in NMFS' second revised proposed rule for the Designation of Critical Habitat for the Arctic Subspecies of the Ringed Seal (86 FR 1452; March 9, 2021), the area proposed for exclusion contains one or more of the essential features of the Arctic ringed seal's critical habitat, although data are limited to inform NMFS' assessment of the relative value of this area to the conservation of the species. As noted above, a portion of the proposed ringed seal critical habitat overlaps the larger proposed ICEX22 Study Area. This overlap includes the portion of the Navy Activity Study Area that overlaps the U.S. EEZ. However, as described later and in more detail in the **Potential Effects of Specified Activities on Marine Mammals and Their Habitat** section, we do not anticipate physical impacts to any marine mammal habitat as a result of the Navy's ICEX activities, including impacts to ringed seal sea ice habitat suitable as a platform for basking and molting and impacts on prey availability. Further, this proposed IHA includes mitigation measures, as described in the **Proposed Mitigation** section, that would minimize or prevent impacts to sea ice habitat suitable for the formation and maintenance of subnivean birth lairs.

Ice Seal Unusual Mortality Event

Since June 1, 2018, elevated strandings of ringed seals, bearded seals, and spotted seals have occurred in the Bering and Chukchi Seas. This event has been declared an Unusual Mortality Event (UME). A UME is defined under the MMPA as a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response. From June 1, 2018 to November 17, 2021, there have been at least 368 dead seals reported; 106 bearded seals, 95 ringed seals, 62 spotted seals, and 105 unidentified seals. All age classes of seals have been reported stranded, and a subset of seals have been sampled for genetics and harmful algal bloom exposure, with a few having histopathology collected. Results are pending, and the cause of the UME remains unknown.

There was a previous UME involving ice seals (which, in Alaska, includes bearded seals, ringed seals, ribbon seals, and spotted seals) from 2011 to 2016, which was most active in 2011-2012. A minimum of 657 seals were affected. The UME investigation determined that some of the clinical signs were due to an abnormal molt, but a definitive cause of death for the UME was never determined. The number of stranded ice seals involved in this current UME, and their physical characteristics, is not at all similar to the 2011-2016 UME, as the seals in the current UME are not exhibiting hair loss or skin lesions, which were a primary finding in the 2011-2016 UME. The investigation into the cause of the current UME is ongoing.

As part of the UME investigation process, NOAA has assembled an independent team of scientists to coordinate with the Working Group on Marine Mammal Unusual Mortality Events to review the data collected, sample stranded seals, and determine the next steps for the investigation. More detailed information is available at: *https://www.fisheries.noaa.gov/alaska/marine-life-distress/2018-2021-ice-seal-unusual-mortality-event-alaska*.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.*, Richardson *et al.* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.*, low-frequency cetaceans). Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 decibel (dB) threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. Marine mammal hearing groups and their associated hearing ranges are provided in Table 2.

Table 2-- Marine Mammal Hearing Groups (NMFS, 2018)

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (*i.e.,* all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al.* 2007) and PW pinniped (approximation).

The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.* 2006; Kastelein *et al.* 2009; Reichmuth and Holt, 2013).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Only ringed seals (a phocid pinniped species) have the reasonable potential to co-occur with the proposed ICEX22 activities.

Potential Effects of Specified Activities on Marine Mammals and Their Habitat

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The **Estimated Take** section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The **Negligible Impact Analysis and Determination** section considers the content of this section, the **Estimated Take** section, and the **Proposed Mitigation** section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks.

Description of Sound Sources

Here, we first provide background information on marine mammal hearing before discussing the potential effects of the use of active acoustic sources on marine mammals.

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in Hz or cycles per second. Wavelength is the distance between two peaks of a sound wave; lower frequency sounds have longer wavelengths than higher frequency sounds and attenuate (decrease) more rapidly in shallower water. Amplitude is the height of the sound pressure wave or the ‘loudness’ of a sound and is typically measured using the dB scale. A dB is the ratio between a measured pressure (with sound) and a reference pressure (sound at a constant pressure, established by scientific standards). It is a logarithmic unit that accounts for large variations in amplitude; therefore, relatively small changes in dB ratings correspond to large changes in sound pressure. When referring to sound pressure levels (SPLs; the sound force per unit area), sound is referenced in the context of underwater sound pressure to 1 microPascal (μPa). One pascal is the pressure resulting from a force of one newton exerted over an area of one square meter. The source level (SL) represents the sound level at a distance of 1 m from the source (referenced to 1 μPa). The received level is the sound level at the listener's position. Note that all underwater sound levels in this document are referenced to a pressure of 1 μPa.

Root mean square (RMS) is the quadratic mean sound pressure over the duration of an impulse. RMS is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick 1983). RMS accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in all directions away from the source (similar to ripples on the surface of a pond), except in cases where the source is directional. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound. Ambient sound is defined as environmental background sound levels lacking a single source or point (Richardson *et al.* 1995), and the sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.*, waves, earthquakes, ice, atmospheric sound), biological (*e.g.*, sounds produced by marine mammals, fish, and invertebrates), and anthropogenic sound (*e.g.*, vessels, dredging, aircraft, construction). A number of sources contribute to ambient sound, including the following (Richardson *et al.* 1995):

- Wind and waves: The complex interactions between wind and water surface, including processes such as breaking waves and wave-induced bubble oscillations and cavitation, are a main source of naturally occurring ambient noise for frequencies between 200 Hz and 50 kHz (Mitson, 1995). Under sea ice, noise generated by ice deformation and ice fracturing may be caused by thermal, wind, drift, and current stresses (Roth *et al.* 2012);

- Precipitation: Sound from rain and hail impacting the water surface can become an important component of total noise at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times. In the ice-covered ICEX22 Study Area, precipitation is unlikely to impact ambient sound;

- Biological: Marine mammals can contribute significantly to ambient noise levels, as can some fish and shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz; and

- Anthropogenic: Sources of ambient noise related to human activity include transportation (surface vessels and aircraft), dredging and construction, oil and gas drilling and production, seismic surveys, sonar, explosions, and ocean acoustic studies. Shipping noise typically dominates the total ambient noise for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly (Richardson *et al.* 1995). Sound from identifiable anthropogenic sources other than the activity of interest (*e.g.*, a passing vessel) is sometimes termed background sound, as opposed to ambient sound. Anthropogenic sources are unlikely to significantly contribute to ambient underwater noise during the late winter and early spring in the ICEX22 Study Area as most anthropogenic activities would not be active due to ice cover (*e.g.* seismic surveys, shipping; Roth *et al.* 2012).

The sum of the various natural and anthropogenic sound sources at any given location and time – which comprise "ambient" or "background" sound – depends not only on the source levels (as determined by current weather conditions and levels of biological and shipping activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 dB from day to day (Richardson *et al.* 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals.

Underwater sounds fall into one of two general sound types: impulsive and non-impulsive (defined in the following paragraphs). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.*, Ward, 1997 in Southall *et al.* 2007). Please see Southall *et al.* (2007) for an in-depth discussion of these concepts.

Impulsive sound sources (*e.g.*, explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI 1986; Harris 1998; NIOSH 1998; ISO 2016; ANSI 2005) and occur either as isolated events or repeated in some succession. Impulsive sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features. There are no pulsed sound sources associated with any planned ICEX22 activities.

Non-impulsive sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous (ANSI 1995; NIOSH 1998). Some of these non-impulsive sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.*, rapid rise time). Examples of non-impulsive sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar sources (such as those planned for use by the Navy as part of the proposed ICEX22 activities) that intentionally direct a sound signal at a target that is reflected back in order to discern physical details about the target.

Modern sonar technology includes a variety of sonar sensor and processing systems. In concept, the simplest active sonar emits sound waves, or “pings,” sent out in multiple directions, and the sound waves then reflect off of the target object in multiple directions. The sonar source calculates the time it takes for the reflected sound waves to return; this calculation determines the distance to the target object. More sophisticated active sonar systems emit a ping and then rapidly scan or listen to the sound waves in a specific area. This provides both distance to the target and directional information. Even more advanced sonar systems use multiple receivers to listen to echoes from several directions simultaneously and provide efficient detection of both direction and distance. In general, when sonar is in use, the sonar ‘pings’ occur at intervals, referred to as a duty cycle, and the signals themselves are very short in duration. For example, sonar that emits a 1-second ping every 10 seconds has a 10 percent duty cycle. The Navy's most powerful hull-mounted mid-frequency sonar source used in ICEX activities typically emits a 1-

second ping every 50 seconds representing a 2 percent duty cycle. The Navy utilizes sonar systems and other acoustic sensors in support of a variety of mission requirements.

Acoustic Impacts

Please refer to the information given previously regarding sound, characteristics of sound types, and metrics used in this document. Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe responses, depending on received levels, duration of exposure, behavioral context, and various other factors. The potential effects of underwater sound from active acoustic sources can include one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al.* 1995; Gordon *et al.* 2004; Nowacek *et al.* 2007; Southall *et al.* 2007; Gotz *et al.* 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing will occur almost exclusively for noise within an animal's hearing range. In this section, we first describe specific manifestations of acoustic effects before providing discussion specific to the proposed activities in the next section.

Permanent Threshold Shift - Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Finneran 2015). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al.* 2007). Repeated sound exposure that leads to TTS could cause PTS. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter 1985).

When PTS occurs, there is physical damage to the sound receptors in the ear (*i.e.*, tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Southall *et al.* 2007). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.*, Ward 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

Relationships between TTS and PTS thresholds have not been studied in marine mammals – PTS data exists only for a single harbor seal (Kastak *et al.* 2008) – but are assumed to be similar to those in humans and other terrestrial mammals. PTS typically occurs at exposure levels at least several dB above (a 40-dB threshold shift approximates PTS onset; *e.g.*, Kryter *et al.* 1966; Miller, 1974) those inducing mild TTS (a 6-dB threshold shift approximates TTS onset; *e.g.,* Southall *et al.* 2007). Based on data from terrestrial mammals, a precautionary assumption is that the PTS thresholds for impulse sounds (such as impact pile driving pulses as received close to the source) are at least six dB higher than the TTS threshold on a peak-pressure basis and PTS cumulative sound exposure level (SEL) thresholds are 15 to 20 dB higher than TTS cumulative SEL thresholds (Southall *et al.* 2007).

Temporary Threshold Shift – TTS is the mildest form of hearing impairment that can occur during exposure to sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard. In terrestrial and marine mammals, TTS can last from minutes or hours to days (in cases of strong TTS). In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends.

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.*, recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin (*Tursiops truncatus)*, beluga whale, harbor porpoise (*Phocoena phocoena*), and Yangtze finless porpoise (*Neophocoena asiaeorientalis*)) and three species of pinnipeds (northern elephant seal (*Mirounga angustirostris*), harbor seal (*Phoca vitulina*), and California sea lion (*Zalophus californianus*)) exposed to a limited number of sound sources (*i.e.*, mostly tones and octave-band noise) in laboratory settings (Finneran 2015). TTS was not observed in trained spotted and ringed seals exposed to impulsive noise at levels matching previous predictions of TTS onset (Reichmuth *et al.* 2016). In general, harbor seals and harbor porpoises have a lower TTS onset than other measured pinniped or cetacean species. Additionally, the existing marine mammal TTS data come from a limited number of individuals within these species. There are no data available on noise-induced hearing loss for mysticetes. For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, please see Southall *et al.* (2007), Finneran and Jenkins (2012), and Finneran (2015).

Behavioral effects – Behavioral disturbance may include a variety of effects, including subtle changes in behavior (*e.g.*, minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Behavioral responses to sound are highly variable and context-specific and any reactions depend on numerous intrinsic and extrinsic factors (*e.g.,* species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day), as well as the interplay between factors (*e.g.*, Richardson *et al.* 1995; Wartzok *et al.* 2003; Southall *et al.* 2007; Weilgart, 2007; Archer *et al.* 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, context, and numerous other factors (Ellison *et al.* 2012), and can vary depending on characteristics associated with the sound source (*e.g.*, whether it is moving or stationary, number of sources, distance from the source). Please see Appendices B-C of Southall *et al.* (2007) for a review of studies involving marine mammal behavioral responses to sound.

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.* 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a "progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial," rather than as, more generally, moderation in response to human disturbance (Bejder *et al.* 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. As noted, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al.*

1995; NRC 2003; Wartzok *et al.* 2003). Controlled experiments with captive marine mammals have shown pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway *et al.* 1997; Finneran *et al.* 2003). Observed responses of wild marine mammals to loud impulsive sound sources (typically seismic airguns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; see also Richardson *et al.* 1995; Nowacek *et al.* 2007).

Available studies show wide variation in response to underwater sound; therefore, it is difficult to predict specifically how any given sound in a particular instance might affect marine mammals perceiving the signal. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (*e.g.*, Lusseau and Bejder 2007; Weilgart 2007; NRC 2003). However, there are broad categories of potential response, which we describe in greater detail here, that include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight.

Changes in dive behavior can vary widely, and may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.*, Frankel and Clark 2000; Costa *et al.* 2003; Ng and Leung, 2003; Nowacek *et al.* 2004; Goldbogen *et al.* 2013). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.*, foraging) or they may be of little biological significance. The impact of an alteration to dive behavior resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.*, bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.,* Croll *et al.* 2001; Nowacek *et al.* 2004; Madsen *et al.* 2006; Yazvenko *et al.* 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Variations in respiration naturally vary with different behaviors and alterations to breathing rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Various studies have shown that respiration rates may either be unaffected or could increase, depending on the species and signal characteristics, again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (*e.g.*, Kastelein *et al.* 2001, 2005b, 2006; Gailey *et al.* 2007).

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect increased vigilance or a startle response. For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al.* 2000; Fristrup *et al.* 2003; Foote *et al.* 2004), while right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.* 2007). In some cases, animals may cease sound production during production of aversive signals (Bowles *et al.* 1994).

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors, and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al.* 1995). For example, gray whales are known to change direction – deflecting from customary migratory paths – in order to avoid noise from seismic surveys (Malme *et al.* 1984). Avoidance may be short-term, with animals returning to the area once the noise has ceased (*e.g.*, Bowles *et al.* 1994; Goold, 1996; Morton and Symonds, 2002; Gailey *et al.* 2007). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.*, Blackwell *et al.* 2004; Bejder *et al.* 2006).

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.*, directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus 1996). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, marine mammal strandings (Evans and England 2001). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves 2008), and whether individuals are solitary or in groups may influence the response.

Behavioral disturbance can also impact marine mammals in more subtle ways. Increased vigilance may result in costs related to diversion of focus and attention (*i.e.*, when a response consists of increased vigilance, it may come at the cost of decreased attention to other critical behaviors such as foraging or resting). These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (*e.g.*, Beauchamp and Livoreil, 1997; Fritz *et al.* 2002; Purser and Radford 2011). In addition, chronic disturbance can cause population declines through reduction of fitness (*e.g.*, decline in body condition) and subsequent reduction in reproductive success, survival, or both *(e.g.*, Harrington and Veitch 1992; Daan *et al.* 1996; Bradshaw *et al.* 1998). However, Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period did not cause any sleep deprivation or stress effects.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Disruption of such functions resulting from reactions to stressors such as sound exposure are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.* 2007). Note that there is a difference between multi-day substantive behavioral reactions and multi-day anthropogenic activities. For example, just because an activity lasts for multiple days does not necessarily mean that individual animals are either exposed to activity-related stressors for multiple days or, further, exposed in a manner resulting in sustained multi-day substantive behavioral responses.

For non-impulsive sounds (*i.e.*, similar to the sources used during the proposed specified activities), data suggest that exposures of pinnipeds to received levels between 90 and 140 dB re 1 μPa do not elicit strong behavioral responses; no data were available for exposures at higher received levels for Southall *et al.* (2007) to include in the severity scale analysis. Reactions of harbor seals were the only available data for which the responses could be ranked on the severity scale. For reactions that were recorded, the majority (17 of 18 individuals/groups) were ranked on the severity scale as a 4 (defined as moderate change in movement, brief shift in group distribution, or moderate change in vocal behavior) or lower; the remaining response was ranked as a 6 (defined as minor or moderate avoidance of the sound source). Additional data on hooded seals (*Cystophora cristata*) indicate avoidance responses to signals above 160–170 dB re 1 μPa (Kvadsheim *et al.* 2010), and data on gray seals (*Halichoerus grypus*) and harbor seals indicate avoidance response at received levels of 135–144 dB re 1 μPa (Götz *et al.* 2010). In each instance where food was available, which provided the seals motivation to remain near the source, habituation to the signals occurred rapidly. In the same study, it was noted that habituation was not apparent in wild seals where no food source was available (Götz *et al.* 2010). This implies that the motivation of the animal is necessary to consider in determining the potential for a reaction. In one study that aimed to investigate the under-ice movements and sensory cues associated with under-ice navigation of ice seals, acoustic transmitters (60–69 kHz at 159 dB re 1 μPa at 1 m) were attached to ringed seals (Wartzok *et al.* 1992a; Wartzok *et al.* 1992b). An acoustic tracking system then was installed in the ice to receive the acoustic signals and provide real-time tracking of ice seal movements. Although the frequencies used in this study are at the upper limit of ringed seal hearing, the ringed seals appeared unaffected by the acoustic transmissions, as they were able to maintain normal behaviors (*e.g.*, finding breathing holes).

Seals exposed to non-impulsive sources with a received sound pressure level within the range of calculated exposures for ICEX activities (142–193 dB re 1 μPa), have been shown to change their behavior by modifying diving activity and avoidance of the sound source (Götz *et al.* 2010; Kvadsheim *et al.* 2010). Although a minor change to a behavior may occur as a result of exposure to the sources in the proposed specified activities, these changes would be within the normal range of behaviors for the animal (*e.g.*, the use of a breathing hole further from the source, rather than one closer to the source, would be within the normal range of behavior; Kelly *et al.* 1988).

Adult ringed seals spend up to 20 percent of the time in subnivean lairs during the winter season (Kelly *et al.* 2010a). Ringed seal pups spend about 50 percent of their time in the lair during the nursing period (Lydersen and Hammill 1993). During the warm season ringed seals haul out on the ice. In a study of ringed seal haulout activity by Born *et al.* (2002), ringed seals spent 25-57 percent of their time hauled out in June, which is during their molting season. Ringed seal lairs are typically used by individual seals (haulout lairs) or by a mother with a pup (birthing lairs); large lairs used by many seals for hauling out are rare (Smith and Stirling 1975). If the non-impulsive acoustic transmissions are heard and are perceived as a threat, ringed seals within subnivean lairs could react to the sound in a similar fashion to their reaction to other threats, such as polar bears (their primary predators). Responses of ringed seals to a variety of human-induced sounds (*e.g.*, helicopter noise, snowmobiles, dogs, people, and seismic activity) have been variable; some seals entered the water and some seals remained in the lair. However, according to Kelly *et al.* (1988), in all instances in which observed seals departed lairs in response to noise disturbance, they subsequently reoccupied the lair.

Ringed seal mothers have a strong bond with their pups and may physically move their pups from the birth lair to an alternate lair to avoid predation, sometimes risking their lives to defend their pups from potential predators (Smith 1987). If a ringed seal mother perceives the proposed acoustic sources as a threat, the network of multiple birth and haulout lairs allows the mother and pup to move to a new lair (Smith and Hammill 1981; Smith and Stirling 1975). The acoustic sources from these proposed specified activities are not likely to impede a ringed seal from finding a breathing hole or lair, as captive seals have been found to primarily use vision to locate breathing holes and no effect to ringed seal vision would occur from the acoustic disturbance (Elsner *et al.* 1989; Wartzok *et al.* 1992a). It is anticipated that a ringed seal would be able to relocate to a different breathing hole relatively easily without impacting their normal behavior patterns.

Stress responses – An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (*e.g.*, Seyle 1950; Moberg 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Neuroendocrine stress responses often involve the hypothalamus-pituitary-adrenal system. Virtually all neuroendocrine functions that are affected by stress – including immune competence, reproduction, metabolism, and behavior – are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction, altered metabolism, reduced immune competence, and behavioral disturbance (*e.g.*, Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticoids are also equated with stress (Romano *et al.* 2004).

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and "distress" is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (*e.g.*, Holberton *et al.* 1996; Hood *et al.* 1998; Jessop *et al.* 2003; Krausman *et al.* 2004; Lankford *et al.* 2005). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker, 2000; Romano *et al.* 2002b) and, more rarely, studied in wild populations (*e.g.*, Romano *et al.* 2002a). These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as "distress." In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

Auditory masking – Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.*, those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation) (Richardson *et al.* 1995). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.*, snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.*, shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.*, signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.*, sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age or TTS hearing loss), and existing ambient noise and propagation conditions.

Under certain circumstances, marine mammals experiencing significant masking could also be impaired from maximizing their performance fitness in survival and reproduction. Therefore, when the coincident (masking) sound is anthropogenic, it may be considered harassment when disrupting or altering critical behaviors. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. For example, low-frequency signals may have less effect on high-frequency echolocation sounds produced by odontocetes but are more likely to affect detection of mysticete communication calls and other potentially important natural sounds such as those produced by surf and some prey species. The masking of communication signals by anthropogenic noise may be considered as a reduction in the communication space of animals (*e.g.*, Clark *et al.* 2009) and may result in energetic or other costs as animals change their vocalization behavior (*e.g.*, Miller *et al.* 2000; Foote *et al.* 2004; Parks *et al.* 2007b; Di Iorio and Clark, 2009; Holt *et al.* 2009). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al.* 1995), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore, 2014). Masking can be tested directly in captive species (*e.g.*, Erbe 2008), but in wild populations it must be either modeled or inferred from evidence of masking compensation. There are few studies addressing real-world masking sounds likely to be experienced by marine mammals in the wild (*e.g.*, Branstetter *et al.* 2013).

Masking affects both senders and receivers of acoustic signals and can potentially have long-term chronic effects on marine mammals at the population level as well as at the individual level. Low-frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand 2009). All anthropogenic sound sources, but especially chronic and lower-frequency signals (*e.g.*, from vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking.

Potential Effects of Sonar on Prey – Ringed seals feed on marine invertebrates and fish. Marine invertebrates occur in the world's oceans, from warm shallow waters to cold deep waters, and are the dominant animals in all habitats of the ICEX22 Study Area. Although most species are found within the benthic zone, marine invertebrates can be found in all zones (sympagic (within the sea ice), pelagic (open ocean), or benthic (bottom dwelling)) of the Beaufort Sea (Josefson *et al.* 2013). The diverse range of species include oysters, crabs, worms, ghost shrimp, snails, sponges, sea fans, isopods, and stony corals (Chess and Hobson 1997; Dugan *et al.* 2000; Proctor *et al.* 1980).

Hearing capabilities of invertebrates are largely unknown (Lovell *et al.* 2005; Popper and Schilt 2008). Outside of studies conducted to test the sensitivity of invertebrates to vibrations, very little is known on the effects of anthropogenic underwater noise on invertebrates (Edmonds *et al.* 2016). While data are limited, research suggests that some of the major cephalopods and decapods may have limited hearing capabilities (Hanlon 1987; Offutt 1970), and may hear only low-frequency (less than 1 kHz) sources (Offutt 1970), which is most likely within the frequency band of biological signals (Hill 2009). In a review of crustacean sensitivity of high amplitude underwater noise by Edmonds *et al.* (2016), crustaceans may be able to hear the frequencies at which they produce sound, but it remains unclear which noises are incidentally produced and if there are any negative effects from masking them. Acoustic signals produced by crustaceans range from low frequency rumbles (20-60 Hz) to high frequency signals (20-55 kHz) (Henninger and Watson 2005; Patek and Caldwell 2006; Staaterman *et al.* 2016). Aquatic invertebrates that can sense local water movements with ciliated cells include cnidarians, flatworms, segmented worms, urochordates (tunicates), mollusks, and arthropods (Budelmann 1992a, 1992b; Popper *et al.* 2001). Some aquatic invertebrates have specialized organs called statocysts for determination of equilibrium and, in some cases, linear or angular acceleration. Statocysts allow an animal to sense movement and may enable some species, such as cephalopods and crustaceans, to be sensitive to water particle movements associated with sound (Goodall *et al.* 1990; Hu *et al.* 2009; Kaifu *et al.* 2008; Montgomery *et al.* 2006; Popper *et al.* 2001; Roberts and Breithaupt 2016; Salmon 1971). Because any acoustic sensory capabilities, if present at all, are limited to detecting water motion, and water particle motion near a sound source falls off rapidly with distance, aquatic invertebrates are probably limited to detecting nearby sound sources rather than sound caused by pressure waves from distant sources.

Studies of sound energy effects on invertebrates are few, and identify only behavioral responses. Non-auditory injury, PTS, TTS, and masking studies have not been conducted for invertebrates. Both behavioral and auditory brainstem response studies suggest that crustaceans may sense frequencies up to 3 kHz, but best sensitivity is likely below 200 Hz (Goodall *et al.* 1990; Lovell *et al.* 2005; Lovell *et al.* 2006). Most cephalopods likely sense low-frequency sound below 1 kHz, with best sensitivities at lower frequencies (Budelmann 2010; Mooney *et al.* 2010; Offutt 1970). A few cephalopods may sense higher frequencies up to 1,500 Hz (Hu *et al.* 2009).

It is expected that most marine invertebrates would not sense the frequencies of the sonar associated with the proposed specified activities. Most marine invertebrates would not be close enough to active sonar systems to potentially experience impacts to sensory structures. Any marine invertebrate capable of sensing sound may alter its behavior if exposed to sonar. Although acoustic transmissions produced during the proposed specified activities may briefly impact individuals, intermittent exposures to sonar are not expected to impact survival, growth, recruitment, or reproduction of widespread marine invertebrate populations.

The fish species located in the ICEX22 Study Area include those that are closely associated with the deep ocean habitat of the Beaufort Sea. Nearly 250 marine fish species have been described in the Arctic, excluding the larger parts of the sub-Arctic Bering, Barents, and Norwegian Seas (Mecklenburg *et al.* 2011). However, only about 30 are known to occur in the Arctic waters of the Beaufort Sea (Christiansen and Reist 2013). Largely because of the difficulty of sampling in remote, ice-covered seas, many high-Arctic fish species are known only from rare or geographically patchy records (Mecklenburg *et al.* 2011). Aquatic systems of the Arctic undergo extended seasonal periods of ice cover and other harsh environmental conditions. Fish inhabiting such systems must be biologically and ecologically adapted to surviving such conditions. Important environmental factors that Arctic fish must contend with include reduced light, seasonal darkness, ice cover, low biodiversity, and low seasonal productivity.

All fish have two sensory systems to detect sound in the water: the inner ear, which functions very much like the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the fish's body (Popper and Fay 2010;

Popper *et al.* 2014). The inner ear generally detects relatively higher-frequency sounds, while the lateral line detects water motion at low frequencies (below a few hundred Hz) (Hastings and Popper 2005). Lateral line receptors respond to the relative motion between the body surface and surrounding water; this relative motion, however, only takes place very close to sound sources and most fish are unable to detect this motion at more than one to two body lengths distance away (Popper *et al.* 2014). Although hearing capability data only exist for fewer than 100 of the approximately 32,000 fish species known to exist, current data suggest that most species of fish detect sounds from 50 to 1,000 Hz, with few fish hearing sounds above 4 kHz (Popper 2008). It is believed that most fish have their best hearing sensitivity from 100 to 400 Hz (Popper 2003). Permanent hearing loss has not been documented in fish. A study by Halvorsen *et al.* (2012) found that for temporary hearing loss or similar negative impacts to occur, the noise needed to be within the fish's individual hearing frequency range; external factors, such as developmental history of the fish or environmental factors, may result in differing impacts to sound exposure in fish of the same species. The sensory hair cells of the inner ear in fish can regenerate after they are damaged, unlike in mammals where sensory hair cells loss is permanent (Lombarte *et al.* 1993; Smith *et al.* 2006). As a consequence, any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (Smith *et al.* 2006), and no permanent loss of hearing in fish would result from exposure to sound.

Fish species in the ICEX22 Study Area are expected to hear the low-frequency sources associated with the proposed specified activities, but most are not expected to detect the higher-frequency sounds. Only a few fish species are able to detect mid-frequency sonar above 1 kHz and could have behavioral reactions or experience auditory masking during these activities. These effects are expected to be transient, and long-term consequences for the population are not expected. Fish with hearing specializations capable of detecting high-frequency sounds are not expected to be within the ICEX22 Study Area. If hearing specialists were present, they would have to be in close vicinity to the source to experience effects from the acoustic transmission. Human-generated sound could alter the behavior of a fish in a manner that would affect its way of living, such as where it tries to locate food or how well it can locate a potential mate; behavioral responses to loud noise could include a startle response, such as the fish swimming away from the source, the fish "freezing" and staying in place, or scattering (Popper 2003). Auditory masking could also interfere with a fish's ability to hear biologically relevant sounds, inhibiting the ability to detect both predators and prey, and impacting schooling, mating, and navigating (Popper 2003). If an individual fish comes into contact with low-frequency acoustic transmissions and is able to perceive the transmissions, they are expected to exhibit short-term behavioral reactions, when initially exposed to acoustic transmissions, which would not significantly alter breeding, foraging, or populations. Overall effects to fish from ICEX22 active sonar sources would be localized, temporary, and infrequent.

Potential Effects of Vessel Strike – Because ICEX22 would occur only when there is ice coverage and conditions are appropriate to establish an ice camp on an ice floe, no ships or smaller boats would be involved in the activity. Vessel use would be limited to submarines and unmanned underwater vehicles (hereafter referred to together as "vessels" unless noted separately). The potential for vessel strike during ICEX22 would therefore only arise from the use of submarines during training and testing activities, and the use of unmanned underwater vehicles during research activities. Depths at which vessels would operate during ICEX22 would overlap with known dive depths of ringed seals, which have been recorded to 300 m in depth (Gjertz *et al.* 2000; Lydersen 1991). Few authors have specifically described the responses of pinnipeds to vessels, and most of the available information on reactions to boats concerns pinnipeds hauled out on land or ice. No information is available on potential responses to submarines or unmanned underwater vehicles. Brueggeman *et al.* (1992) stated ringed seals hauled out on the ice showed short-term escape reactions when they were within 0.25–0.5 km from a vessel; ringed seals would likely show similar reactions to submarines and unmanned underwater vehicles, decreasing the likelihood of vessel strike during ICEX22 activities.

Dating back more than 20 years and for as long as it has kept records, the Navy has no records of individual pinnipeds being struck by a vessel as a result of Navy activities and, further, the smaller size and maneuverability of pinnipeds make a vessel strike unlikely. Also, NMFS has never received any reports indicating that pinnipeds have been struck by vessels of any type. Review of additional sources of information in the form of worldwide ship strike records shows little evidence of strikes of pinnipeds from the shipping sector. Further, a review of seal stranding data from Alaska found that during 2020, 9 ringed seal strandings were recorded by the Alaska Marine Mammal Stranding Network. Within the Arctic region of Alaska, 7 ringed seal strandings were recorded. Of the 9 strandings reported in Alaska (all regions included), none were found to be caused by vessel collisions (Savage 2021).

Vessel speed, size, and mass are all important factors in determining both the potential likelihood and impacts of a vessel strike to marine mammals (Conn and Silber, 2013; Gende *et al.* 2011; Silber *et al.* 2010; Vanderlaan and Taggart, 2007; Wiley *et al.* 2016). When submerged, submarines are generally slow moving (to avoid detection) and therefore marine mammals at depth with a submarine are likely able to avoid collision with the submarine. For most of the research and training and testing activities during the specified activity, submarine and unmanned underwater vehicle speeds would not typically exceed 10 knots during the time spent within the ICEX22 Study Area, which would lessen the already extremely unlikely chance of collisions with marine mammals, specifically ringed seals.

Based on consideration of all this information, NMFS does not anticipate incidental take of marine mammals by vessel strike from submarines or unmanned underwater vehicles.

Potential Effects of Exercise Weapon Strike – As noted in the *Detailed Description of Specific Activity* section, the Navy may use up to 20 inert exercise weapons in ICEX22. While the details of the proposed exercise weapon exercises are classified, given the limited potential number of exercise weapons deployed during the exercise window, and the low density of ringed seals in the project area during this time, NMFS does not anticipate incidental take of marine mammals by exercise weapon strike.

Effects of Acoustics on Physical and Foraging Habitat – Unless the sound source is stationary and/or continuous over a long duration in one area, neither of which applies to ICEX22 activities, the effects of the introduction of sound into the environment are generally considered to have a less severe impact on marine mammal habitat compared to any physical alteration of the habitat. Acoustic exposures are not expected to result in long-term physical alteration of the water column or bottom topography as the occurrences are of limited duration and would occur intermittently. Acoustic transmissions also would have no structural impact to subnivean lairs in the ice. Furthermore, since ice dampens acoustic transmissions (Richardson *et al.* 1995) the level of sound energy that reaches the interior of a subnivean lair would be less than that ensonifying water under surrounding ice. For these reasons, it is unlikely that the Navy's acoustic activities in the ICEX22 Study Area would have any effect on marine mammal habitat, including habitat that was considered for designation as ESA critical habitat in the current ESA rulemaking process.

Non-acoustic Impacts – Deployment of the ice camp could potentially affect ringed seal habitat by physically damaging or crushing subnivean lairs, which could potentially result in ringed seal injury or mortality. March 1 is generally expected to be the onset of ice seal lairing season, and ringed seals typically construct lairs near pressure ridges. As described in the **Proposed Mitigation** section, the ice camp and runway would be established on a combination of first-year ice and multi-year ice without pressure ridges, which would minimize the possibility of physical impacts to subnivean lairs and habitat suitable for lairs. Ice camp deployment would begin mid-February, and be gradual, with activity increasing over the first five days. So in addition, this schedule would discourage seals from establishing birthing lairs in or near the ice camp, and would allow ringed seals to relocate outside of the ice camp area as needed, though both scenarios are unlikely as described below in this section. Personnel on on-ice vehicles would observe for marine mammals, and would follow established routes when available, to avoid potential disturbance of lairs and habitat suitable for lairs. Personnel on foot and operating on-ice vehicles would avoid deep snow drifts near pressure ridges, also to avoid potential lairs and habitat suitable for lairs. Implementation of these measures are expected to prevent ringed seal lairs from being crushed or damaged during ICEX22 activities, and are expected to minimize any other potential impacts to sea ice habitat suitable for the formation of lairs. Given the proposed mitigation requirements, we also do not anticipate ringed seal injury or mortality as a result of damage to subnivean lairs.

ICEX22 personnel would be actively conducting testing and training operations on the sea ice and would travel around the camp area, including the runway, on snowmobiles. Although the Navy does not anticipate observing any seals on the ice given the lack of observations during previous ice exercises (U.S. Navy, 2020), it is possible that the presence of active humans could behaviorally disturb ringed seals that are in lairs or on the ice. For example, if a seal is present and would have otherwise built a lair in the area of the ice camp, it could be displaced, or a seal may choose to relocate to a different, existing lair outside of the ice camp area. Displacement of seal lair construction or relocation to existing lairs outside of the ice camp area is unlikely, given the low average density of structures (the average ringed seal ice structure density in the vicinity of Prudhoe Bay, Alaska is 1.58 structures per km^2 (Table 3)), the lack of previous ringed seal observations on the ice during ICEX activities, and proposed mitigation requirements that would require the Navy to construct the ice camp and runway on first-year or multiyear ice without pressure ridges and would require personnel to avoid areas of deep snow drift or pressure ridges.

Table 3-- Ringed Seal Ice Structure Density in the Vicinity of the Prudhoe Bay, Alaska

Year	Ice Structure Density (Structures per km^2)	Source
1982	3.6	Frost and Burns 1989
1983	0.81	Kelly *et al.* 1986
1999	0.71	Williams *et al.* 2001
2000	1.2	Williams *et al.* 2001
Average Density	1.58	

Given the required mitigation measures and the low density of ringed seals anticipated in the Ice Camp Study Area during ICEX22, we do not anticipate behavioral disturbance of ringed seals due to human presence.

The Navy’s activities would occur prior to the late spring to early summer “basking period,” which occurs between abandonment of the subnivean lairs and melting of the seasonal sea ice, and is when the seals undergo their annual molt (Kelly *et al.* 2010b). Given that the ice camp would be demobilized prior to the basking period, and the remainder of the Navy’s activities occur below the sea ice, impacts to sea ice habitat suitable as a platform for basking and molting are not anticipated to result from the Navy's ICEX22 activities.

Our preliminary determination of potential effects to the physical environment includes minimal possible impacts to marine mammals and their habitat from camp operation or deployment activities, given the proposed mitigation and the timing of the Navy's proposed activities. In addition, given the relatively short duration of submarine testing and training activities, the relatively small area that would be affected, and the lack of impacts to physical or foraging habitat, the proposed specified activities are not likely to have an adverse effect on prey species or marine mammal habitat, other than potential localized, temporary, and infrequent effects to fish as discussed above. Therefore, any impacts to ringed seals and their habitat, as discussed above in this section, are not expected to cause significant or long-term consequences for individual ringed seals or the population. Please see the **Negligible Impact Analysis and Determination** section for additional discussion regarding the likely impacts of the Navy's activities on ringed seals, including the reproductive success or survivorship of individual ringed seals, and how those impacts on individuals are likely to impact the species or stock.

Estimated Take

This section provides an estimate of the number of incidental takes proposed for authorization through this IHA, which will inform NMFS' analysis for the negligible impact determination.

Harassment is the only type of take expected to result from these activities. For this military readiness activity, the MMPA defines "harassment" as (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) Any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where the behavioral patterns are abandoned or significantly altered (Level B harassment).

Authorized takes for the Navy's ICEX22 activities would be by Level B harassment only, in the form of disruption of behavioral patterns and/or TTS for individual marine mammals resulting from exposure to acoustic transmissions. Based on the nature of the activity, Level A harassment is neither anticipated nor proposed to be authorized. As described previously, no mortality or serious injury is anticipated or proposed to be authorized for this activity. Below we describe how the incidental take is estimated.

Generally speaking, we estimate take by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally disturbed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and (4) the number of days of activities. For this proposed IHA, the Navy employed a sophisticated model known as the Navy Acoustic Effects Model (NAEMO) to assess the estimated impacts of underwater sound.

Acoustic Thresholds

NMFS recommends the use of acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally disturbed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment by behavioral disturbance for non-explosive sources – In coordination with NMFS, the Navy developed behavioral thresholds to support environmental analyses for the Navy's testing and training military readiness activities utilizing active sonar sources; these behavioral harassment thresholds are used here to evaluate the potential effects of the active sonar components of the proposed specified activities. The behavioral response of a marine mammal to an anthropogenic sound will depend on the frequency, duration, temporal pattern, and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (*i.e.*, what the animal is doing at the time of the exposure). The distance from the sound source and whether it is perceived as approaching or moving away can also affect the way an animal responds to a sound (Wartzok *et al.* 2003). For marine mammals, a review of responses to anthropogenic sound was first conducted by Richardson *et al.* (1995). Reviews by Nowacek *et al.* (2007) and Southall *et al.* (2007) address studies conducted since 1995 and focus on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated.

Multi-year research efforts have conducted sonar exposure studies for odontocetes and mysticetes (Miller *et al.* 2012; Sivle *et al.* 2012). Several studies with captive animals have provided data under controlled circumstances for odontocetes and pinnipeds (Houser *et al.* 2013a; Houser *et al.* 2013b). Moretti *et al.* (2014) published a beaked whale dose-response curve based on PAM of beaked whales during Navy training activity at Atlantic Underwater Test and Evaluation Center during actual Anti-Submarine Warfare exercises. This new information necessitated the update of the behavioral response criteria for the Navy's environmental analyses.

Southall *et al.* (2007) synthesized data from many past behavioral studies and observations to determine the likelihood of behavioral reactions at specific sound levels. While in general, the louder the sound source the more intense the behavioral response, it was clear that the proximity of a sound source and the animal's experience, motivation, and conditioning were also critical factors influencing the response (Southall *et al.* 2007). After examining all of the available data, the authors felt that the derivation of thresholds for behavioral response based solely on exposure level was not supported because context of the animal at the time of sound exposure was an important factor in estimating response. Nonetheless, in some conditions, consistent avoidance reactions were noted at higher sound levels depending on the marine mammal species or group, allowing conclusions to be drawn. Phocid seals showed avoidance reactions at or below 190 dB re 1 μPa at 1 m; thus, seals may actually receive levels adequate to produce TTS before avoiding the source.

The Navy's Phase III proposed pinniped behavioral threshold was updated based on controlled exposure experiments on the following captive animals: Hooded seal, gray seal, and California sea lion (Götz *et al.* 2010; Houser *et al.* 2013a; Kvadsheim *et al.* 2010). Overall exposure levels were 110-170 dB re 1 μPa for hooded seals, 140-180 dB re 1 μPa for gray seals, and 125-185 dB re 1 μPa for California sea lions; responses occurred at received levels ranging from 125 to 185 dB re 1 μPa. However, the means of the response data were between 159 and 170 dB re 1 μPa. Hooded seals were exposed to increasing levels of sonar until an avoidance response was observed, while the grey seals were exposed first to a single received level multiple times, then an increasing received level. Each individual California sea lion was exposed to the same received level ten times. These exposure sessions were combined into a single response value, with an overall response assumed if an animal responded in any single session. Because these data represent a dose-response type relationship between received level and a response, and because the means were all tightly clustered, the Bayesian biphasic Behavioral Response Function for pinnipeds most closely resembles a traditional sigmoidal dose-response function at the upper received levels and has a 50 percent probability of response at 166 dB re 1 μPa. Additionally, to account for proximity to the source discussed above and based on the best scientific information, a conservative distance of 10 km is used beyond which exposures would not constitute a take under the military readiness definition of Level B harassment. The Navy proposed, and NMFS concurs with, the use of this dose response function to predict behavioral harassment of pinnipeds for this activity.

Level A harassment and Level B harassment by threshold shift for non-explosive sources - NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0; Technical Guidance, 2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive).

These thresholds were developed by compiling the best available science and soliciting input multiple times from both the public and peer reviewers to inform the final product. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2018 Technical Guidance, which may be accessed at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance*.

The Navy's PTS/TTS analysis begins with mathematical modeling to predict the sound transmission patterns from Navy sources, including sonar. These data are then coupled with marine species distribution and abundance data to determine the sound levels likely to be received by various marine species. These criteria and thresholds are applied to estimate specific effects that animals exposed to Navy-generated sound may experience. For weighting function derivation, the most critical data required are TTS onset exposure levels as a function of exposure frequency. These values can be estimated from published literature by examining TTS as a function of sound exposure level (SEL) for various frequencies.

To estimate TTS onset values, only TTS data from behavioral hearing tests were used. To determine TTS onset for each subject, the amount of TTS observed after exposures with different SPLs and durations were combined to create a single TTS growth curve as a function of SEL. The use of (cumulative) SEL is a simplifying assumption to accommodate sounds of various SPLs, durations, and duty cycles. This is referred to as an “equal energy” approach, since SEL is related to the energy of the sound and this approach assumes exposures with equal SEL result in equal effects, regardless of the duration or duty cycle of the sound. It is well known that the equal energy rule will over-estimate the effects of intermittent noise, since the quiet periods between noise exposures will allow some recovery of hearing compared to noise that is continuously present with the same total SEL (Ward 1997). For continuous exposures with the same SEL but different durations, the exposure with the longer duration will also tend to produce more TTS (Finneran *et al.* 2010; Kastak *et al.* 2007; Mooney *et al.* 2009a).

As in previous acoustic effects analysis (Finneran and Jenkins 2012; Southall *et al.* 2007), the shape of the PTS exposure function for each species group is assumed to be identical to the TTS exposure function for each group. A difference of 20 dB between TTS onset and PTS onset is used for all marine mammals including pinnipeds. This is based on estimates of exposure levels actually required for PTS (*i.e.*, 40 dB of TTS) from the marine mammal TTS growth curves, which show differences of 13 to 37 dB between TTS and PTS onset in marine mammals. Details regarding these criteria and thresholds can be found in NMFS' Technical Guidance (NMFS 2018).

Table 4 below provides the weighted criteria and thresholds used in this analysis for estimating quantitative acoustic exposures of marine mammals from the proposed specified activities.

Table 4—Acoustic Thresholds Identifying the Onset of Behavioral Disturbance, TTS, and PTS for Non-Impulsive Sound Sources[1]

Functional	Species	Behavioral Criteria	Physiological Criteria

hearing group			TTS threshold SEL (weighted)	PTS threshold SEL (weighted)
Phocid Pinnipeds (Underwater)	Ringed seal	Pinniped Dose Response Function[2]	181 dB SEL cumulative	201 dB SEL cumulative

[1]The threshold values provided are assumed for when the source is within the animal's best hearing sensitivity. The exact threshold varies based on the overlap of the source and the frequency weighting.
[2]See Figure 6-1 in the Navy's IHA application.
Note: SEL thresholds in dB re: 1 μPa^2 s

Quantitative Modeling

The Navy performed a quantitative analysis to estimate the number of marine mammals that could be harassed by the underwater acoustic transmissions during the proposed specified activities. Inputs to the quantitative analysis included marine mammal density estimates, marine mammal depth occurrence distributions (U.S Department of the Navy, 2017), oceanographic and environmental data, marine mammal hearing data, and criteria and thresholds for levels of potential effects.

The density estimate used to estimate take is derived from habitat-based modeling by Kaschner *et al.* (2006) and Kaschner (2004). The area of the Arctic where the proposed specified activities would occur (100-200 nmi north of Prudhoe Bay, Alaska) has not been surveyed in a manner that supports quantifiable density estimation of marine mammals. In the absence of empirical survey data, information on known or inferred associations between marine habitat features and (the likelihood of) the presence of specific species have been used to predict densities using model-based approaches. These habitat suitability models include relative environmental suitability (RES) models. Habitat suitability models can be used to understand the possible extent and relative expected concentration of a marine species distribution. These models are derived from an assessment of the species occurrence in association with evaluated environmental explanatory variables that results in defining the RES suitability of a given environment. A fitted model that quantitatively describes the relationship of occurrence with the environmental variables can be used to estimate unknown occurrence in conjunction with known habitat suitability. Abundance can thus be estimated for each RES value based on the values of the environmental variables, providing a means to estimate density for areas that have not been surveyed. Use of the Kaschner's RES model resulted in a value of 0.3957 ringed seals per km^2 in the cold season (defined as December through May).

The quantitative analysis consists of computer modeled estimates and a post-model analysis to determine the number of potential animal exposures. The model calculates sound energy propagation from the proposed sonars, the sound received by animat (virtual animal) dosimeters representing marine mammals distributed in the area around the modeled activity, and whether the sound received by a marine mammal exceeds the thresholds for effects.

The Navy developed a set of software tools and compiled data for estimating acoustic effects on marine mammals without consideration of behavioral avoidance or Navy's standard mitigations (Lookouts, safety zones, avoidance zones, etc.). These tools and data sets are integral components of NAEMO. In NAEMO, animats are distributed non-uniformly based on species-specific density, depth distribution, and group size information, and animats record energy received at their location in the water column. A fully three-dimensional environment is used for calculating sound propagation and animat exposure in NAEMO. Site-specific bathymetry, sound speed profiles, wind speed, and bottom properties are incorporated into the propagation modeling process. NAEMO calculates the likely propagation for various levels of energy (sound or pressure) resulting from each source used during the training or testing event.

NAEMO then records the energy received by each animat within the energy footprint of the event and calculates the number of animats having received levels of energy exposures that fall within defined impact thresholds. Predicted effects on the animats within a scenario are then tallied and the highest order effect (based on severity of criteria; *e.g.*, PTS over TTS) predicted for a given animat is assumed. Each scenario or each 24-hour period for scenarios lasting greater than 24 hours is independent of all others, and therefore, the same individual marine animal could be impacted during each independent scenario or 24-hour period. In a few instances for the modeling of the specified activities here, although the activities themselves all occur within the ICEX22 Study Area, sound may propagate beyond the boundary of the ICEX22 Study Area. Any exposures occurring outside the boundary of the study area are counted as if they occurred within the ICEX22 Study Area boundary. NAEMO provides the initial estimated impacts on marine species with a static horizontal distribution.

There are limitations to the data used in the acoustic effects model, and the results must be interpreted within this context. While the most accurate data and input assumptions have been used in the modeling, when there is a lack of definitive data to support an aspect of the modeling, modeling assumptions believed to overestimate the number of exposures have been chosen:

- Animats are modeled as being underwater, stationary, and facing the source and therefore always predicted to receive the maximum sound level (*i.e.*, no porpoising or pinnipeds' heads above water);
- Animats do not move horizontally (but do change their position vertically within the water column), which may overestimate physiological effects such as hearing loss, especially for slow moving or stationary sound sources in the model;
- Animats are stationary horizontally and therefore do not avoid the sound source, unlike in the wild where animals would most often avoid exposures at higher sound levels, especially those exposures that may result in PTS;
- Multiple exposures within any 24-hour period are considered one continuous exposure for the purposes of calculating the temporary or permanent hearing

loss, because there are not sufficient data to estimate a hearing recovery function for the time between exposures; and

- Mitigation measures that would be implemented were not considered in the model. In reality, sound-producing activities would be reduced, stopped, or delayed if marine mammals are detected by submarines via PAM.

Because of these inherent model limitations and simplifications, model-estimated results must be further analyzed, considering such factors as the range to specific effects, avoidance, and typically the likelihood of successfully implementing mitigation measures. This analysis uses a number of factors in addition to the acoustic model results to predict effects on marine mammals.

For non-impulsive sources, NAEMO calculates the sound pressure level (SPL) and sound exposure level (SEL) for each active emission during an event. This is done by taking the following factors into account over the propagation paths: Bathymetric relief and bottom types, sound speed, and attenuation contributors such as absorption, bottom loss, and surface loss. Platforms such as a ship using one or more sound sources are modeled in accordance with relevant vehicle dynamics and time durations by moving them across an area whose size is representative of the training event's operational area. Table 5 provides range to effects for active acoustic sources proposed for ICEX22 to phocid pinniped-specific criteria. Phocids within these ranges would be predicted to receive the associated effect. Range to effects is important information in not only predicting acoustic impacts, but also in verifying the accuracy of model results against real-world situations and determining adequate mitigation ranges to avoid higher level effects, especially physiological effects, to marine mammals.

Table 5—Range to Behavioral Disturbance, TTS, and PTS in the ICEX22 Study Area

Source/Exercise	Range to Effects (m)

	Behavioral Disturbance	TTS	PTS
Submarine Exercise	10,000[a]	3,025	130

[a] Empirical evidence has not shown responses to sonar that would constitute take beyond a few km from an acoustic source, which is why NMFS and the Navy conservatively set a distance cutoff of 10 km. Regardless of the source level at that distance, take is not estimated to occur beyond 10 km from the source.

As discussed above, within NAEMO, animats do not move horizontally or react in any way to avoid sound. Furthermore, mitigation measures that are implemented during training or testing activities that reduce the likelihood of physiological impacts are not considered in quantitative analysis. Therefore, the current model overestimates acoustic impacts, especially physiological impacts near the sound source. The behavioral criteria used as a part of this analysis acknowledges that a behavioral reaction is likely to occur at levels below those required to cause hearing loss (TTS or PTS). At close ranges and high sound levels approaching those that could cause PTS, avoidance of the area immediately around the sound source is the assumed behavioral response for most cases.

In previous environmental analyses, the Navy has implemented analytical factors to account for avoidance behavior and the implementation of mitigation measures. The application of avoidance and mitigation factors has only been applied to model-estimated PTS exposures given the short distance over which PTS is estimated. Given that no PTS exposures were estimated during the modeling process for these proposed specified activities, the implementation of avoidance and mitigation factors were not included in this analysis.

Table 6 shows the exposures expected for ringed seals based on NAEMO modeled results.

Table 6—Quantitative Modeling Results of Potential Exposures for ICEX Activities

Species	Level B Harassment		Level A Harassment	Total
	Behavioral Disturbance	TTS		
Ringed seal	3,976	910	0	4,886

During monitoring for the 2018 IHA covering similar military readiness activities in the ICEX22 Study Area, the Navy did not visually observe or acoustically detect any marine mammals (U.S. Navy, 2018). During monitoring for the 2020 IHA covering similar military readiness activities in the ICEX22 Study Area, the Navy also did not visually observe any marine mammals (U.S. Navy, 2020). Acoustic monitoring associated with the 2020 IHA did not detect any discernible marine mammal vocalizations (Henderson *et al*. 2021). The monitoring report states that "there were a few very faint sounds that could have been [ringed seal] barks or yelps." However, these were likely not from ringed seals, given that ringed seal vocalizations are generally produced in series (Jones *et al*. 2014). Henderson *et al*. (2021) expect that these sounds were likely ice-associated or perhaps anthropogenic.

Proposed Mitigation

In order to issue an IHA under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to the activity, and other means of effecting the least practicable impact on the species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the species or stock for taking for certain subsistence uses. NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting the activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)). The 2004 NDAA amended the MMPA as it relates to military readiness activities and the incidental take authorization process such that "least practicable impact" shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

(1) The manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks, and their habitat, as well as subsistence uses. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned) and the likelihood of effective implementation (probability implemented as planned), and;

(2) The practicability of the measures for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

Mitigation for Marine Mammals and their Habitat

Appropriate personnel (including civilian personnel) involved in mitigation and training or testing activity reporting under the specified activities must complete Arctic Environmental and Safety Awareness Training. Modules include: Arctic Species Awareness and Mitigations, Environmental Considerations, Hazardous Materials Management, and General Safety.

Further, NMFS proposes requiring the following general mitigation measures to prevent incidental take of ringed seals on the ice floe associated with the ice camp (further explanation of certain mitigation measures is provided in parentheses following the measure):

- The ice camp and runway must be established on first-year and multi-year ice without pressure ridges. (This will minimize physical impacts to subnivean lairs and impacts to sea ice habitat suitable for lairs.);
- Ice camp deployment must begin no later than mid-February 2022, and be gradual, with activity increasing over the first five days. Camp deployment must be completed by March 15, 2022. (This schedule should discourage seals from establishing birthing lairs in or near the ice camp, and would allow ringed seals to relocate outside of the ice camp area as needed, though as stated above, both are unlikely. Based on the best available science, Arctic ringed seal whelping is not expected to occur prior to mid-March, and therefore, construction of the ice camp would be completed prior to whelping in the area of ICEX22. As such, pups are not anticipated to be in the vicinity of the camp at commencement, and mothers would not need to move newborn pups due to construction of the camp.);
- Personnel on all on-ice vehicles must observe for marine and terrestrial animals;
- Snowmobiles must follow established routes, when available. On-ice vehicles must not be used to follow any animal, with the exception of actively deterring polar bears if the situation requires;
- Personnel on foot and operating on-ice vehicles must avoid areas of deep snowdrifts near pressure ridges. (These areas are preferred areas for subnivean lair development.);
- Personnel must maintain a 100 m (328 ft) avoidance distance from all observed mammals; and
- All material (*e.g.*, tents, unused food, excess fuel) and wastes (*e.g.*, solid waste, hazardous waste) must be removed from the ice floe upon completion of ICEX22 activities.

NMFS proposes requiring the following mitigation measures for activities involving acoustic transmissions (further explanation of certain mitigation measures is provided in parentheses following the measure):

- Personnel must begin passive acoustic monitoring (PAM) for vocalizing marine mammals 15 minutes prior to the start of activities involving active acoustic transmissions from submarines and exercise weapons.
- Personnel must delay active acoustic transmissions and exercise weapon launches if a marine mammal is detected during pre-activity PAM and must shutdown active acoustic transmissions if a marine mammal is detected during acoustic transmissions.
- Personnel must not restart acoustic transmissions or exercise weapon launches until 15 minutes have passed with no marine mammal detections.

Ramp up procedures for acoustic transmissions are not proposed as the Navy determined, and NMFS concurs, that they would result in impacts on military readiness and on the realism of training that would be impracticable.

NMFS proposes requiring the following mitigation measures for aircraft activities to prevent incidental take of marine mammals due to the presence of aircraft and associated noise.

- Fixed wing aircraft must operate at highest altitudes practicable taking into account safety of personnel, meteorological conditions, and need to support safe operations of a drifting ice camp. Aircraft must not reduce altitude if a seal is observed on the ice. In general, cruising elevation must be 305 m (1,000 ft) or higher.
- Unmanned Aircraft Systems (UASs) must maintain a minimum altitude of at least 15.2 m (50 ft) above the ice. They must not be used to track or follow marine mammals.

- Helicopter flights must use prescribed transit corridors when traveling to or from Prudhoe Bay and the ice camp. Helicopters must not hover or circle above marine mammals or within 457 m (1,500 ft) of marine mammals.
- Aircraft must maintain a minimum separation distance of 1.6 km (1 mi) from groups of 5 or more seals.
- Aircraft must not land on ice within 800 m (0.5 mi) of hauled-out seals.

Based on our evaluation of the Navy’s proposed mitigation measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104(a)(13) require requests for authorizations to include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the area of the specified activity. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.*, presence, abundance, distribution, density).

- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.*, source characterization, propagation, ambient noise); (2) affected species (*e.g.*, life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.*, age, calving, or feeding areas).
- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors.
- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks.
- Effects on marine mammal habitat (*e.g.*, marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat).
- Mitigation and monitoring effectiveness.

The U.S. Navy has coordinated with NMFS to develop an overarching program, the Integrated Comprehensive Monitoring Program (ICMP), intended to coordinate marine species monitoring efforts across all regions and to allocate the most appropriate level and type of effort for each range complex based on a set of standardized objectives, and in acknowledgement of regional expertise and resource availability. The ICMP was created in direct response to Navy permitting requirements established in various MMPA regulations and ESA consultations. As a framework document, the ICMP applies by regulation to those activities on ranges and operating areas for which the Navy is seeking or has sought incidental take authorizations.

The ICMP is focused on Navy training and testing ranges where the majority of Navy activities occur regularly, as those areas have the greatest potential for being impacted by the Navy's activities. In comparison, ICEX is a short duration exercise that occurs approximately every other year. Due to the location and expeditionary nature of the ice camp, the number of personnel onsite is extremely limited and is constrained by the requirement to be able to evacuate all personnel in a single day with small planes. As such, the Navy asserts that a dedicated monitoring project would not be feasible as it would require additional personnel and equipment.

The Navy would conduct the following monitoring and reporting under the proposed IHA. In the event that personnel discover an injured or dead marine mammal, personnel must report the incident to the Office of Protected Resources (OPR), NMFS and to the Alaska regional stranding network as soon as feasible. The report must include the following information:

- Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
- Species identification (if known) or description of the animal(s) involved;
- Condition of the animal(s) (including carcass condition if the animal is dead);
- Observed behaviors of the animal(s), if alive;
- If available, photographs or video footage of the animal(s); and
- General circumstances under which the animal(s) was discovered (*e.g.*, during submarine activities, observed on ice floe, or by transiting aircraft).

In addition, the Navy would be required to provide NMFS with a draft exercise monitoring report within 90 days of the conclusion of the specified activity. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of receipt of the draft report, the report shall be considered final. The report would include the number of marine mammals sighted, by species, and any other available information about the sighting(s) such as date, time, and approximate location (latitude and longitude).

All sonar usage would be collected via the Navy's Sonar Positional Reporting System database. The Navy would be required to provide data regarding sonar use and the number of shutdowns during ICEX22 monitoring in the Atlantic Fleet Training and Testing (AFTT) Letter of Authorization 2023 annual classified report. The Navy would also be required to analyze any declassified underwater recordings collected during ICEX22 for marine mammal vocalizations and report that information to NMFS, including the types and natures of sounds heard (*e.g.*, clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal) and the species or taxonomic group (if determinable). This information would also be submitted to NMFS with the 2023 annual AFTT declassified monitoring report.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.*, intensity, duration), the context of any responses (*e.g.*, critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS's implementing regulations (54 FR 40338;

September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*, as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

Underwater acoustic transmissions associated with ICEX22, as outlined previously, have the potential to result in Level B harassment of ringed seals in the form of TTS and behavioral disturbance. No take by Level A harassment, serious injury, or mortality are anticipated to result from this activity. Further, at close ranges and high sound levels approaching those that could cause PTS, seals would likely avoid the area immediately around the sound source.

NMFS estimates 910 takes of ringed seals by TTS from the submarine activities. TTS is a temporary impairment of hearing and can last from minutes or hours to days (in cases of strong TTS). In many cases, however, hearing sensitivity recovers rapidly after exposure to the sound ends. This activity has the potential to result in only minor levels of TTS, and hearing sensitivity of affected animals would be expected to recover quickly. Though TTS may occur as indicated, the overall fitness of the impacted individuals is unlikely to be affected given the temporary nature of TTS and the minor levels of TTS expected from these activities. Negative impacts on the reproduction or survival of affected ring seals as well as impacts on the stock are not anticipated.

Effects on individuals that are taken by Level B harassment by behavioral disturbance could include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight. More severe behavioral responses are not anticipated due to the localized, intermittent use of active acoustic sources and mitigation using PAM, which would limit exposure to active acoustic sources. Most likely, individuals would be temporarily displaced by moving away from the sound source. As described previously in the *Acoustic Impacts* section, seals exposed to non-impulsive sources with a received sound pressure level within the range of calculated exposures, (142-193 dB re 1 μPa), have been shown to change their behavior by modifying diving activity and avoidance of the sound source (Götz *et al.* 2010; Kvadsheim *et al.* 2010). Although a minor change to a behavior may occur as a result of exposure to the sound sources associated with the proposed specified activity, these changes would be within the normal range of behaviors for the animal (*e.g.*, the use of a breathing hole further from the source, rather than one closer to the source). Thus, even repeated Level B harassment of some small subset of the overall stock is unlikely to result in any significant realized decrease in fitness for the affected individuals, and would not result in any adverse impact on reproduction or survival of affected individuals or to the stock as a whole.

The Navy's proposed activities are localized and of relatively short duration. While the total ICEX22 Study Area is large, the Navy expects that most activities would occur within the Ice Camp Study Area in relatively close proximity to the ice camp. The larger Navy Activity Study Area depicts the range where submarines may maneuver during the exercise. The ice camp would be in existence for up to six weeks with acoustic transmission occurring intermittently over approximately four weeks.

The project is not expected to have significant adverse effects on marine mammal habitat. The project activities are limited in time and would not modify physical marine mammal habitat. While the activities may cause some fish to leave a specific area ensonified by acoustic transmissions, temporarily impacting marine mammals' foraging opportunities, these fish would likely return to the affected area. As such, the impacts to marine mammal habitat are not expected to cause significant or long-term negative consequences.

For on-ice activity, Level A harassment, Level B harassment, serious injury, and mortality are not anticipated, given the nature of the activities, the lack of previous ringed seal observations, and the mitigation measures NMFS has proposed to include in the IHA. The ringed seal pupping season on the ice lasts for five to nine weeks during late winter and spring. As stated in the **Potential Effects of Specified Activities on Marine Mammals and Their Habitat** section, March 1 is generally expected to be the onset of ice seal lairing season. The ice camp and runway would be established on multi-year ice without pressure ridges, where ringed seals tend to build their lairs. Ice camp deployment would begin mid-February, and be gradual, with activity increasing over the first five days. This schedule is expected to discourage seals from establishing birthing lairs near the ice camp, and would allow ringed seals to relocate outside of the ice camp area as needed (though as stated above, such instances are unlikely given the low average density of structures, the lack of previous ringed seals observations on the ice during ICEX activities, and proposed mitigation requirements that would require the Navy to construct the ice camp and runway on first-year or multiyear ice without pressure ridges). Ice camp deployment would be completed by March 15, before the pupping season. This would allow ringed seals to avoid the ice camp area once the pupping season begins, thereby avoiding potential impacts to nursing mothers and pups. Furthermore, ringed seal mothers are known to physically move pups from the birth lair to an alternate lair to avoid predation. If a ringed seal mother perceives the acoustic transmissions as a threat, the local network of multiple birth and haulout lairs would allow the mother and pup to move to a new lair.

Mitigation measures would also avoid damage to and disturbance of ringed seals and their lairs that could otherwise result from on-ice activities. Personnel on on-ice vehicles would observe for marine mammals, and would follow established routes when available, to avoid potential damage to or disturbance of lairs. Personnel on foot and operating on-ice vehicles would avoid deep snow drifts near pressure ridges, also to avoid potential damage to or disturbance of lairs. Further, personnel would maintain a 100 m distance from all observed marine mammals to avoid disturbing the animals due to the personnel's presence. Implementation of these measures would prevent ringed seal lairs from being crushed or damaged during ICEX22 activities and would prevent seals and pups from abandoning and relocating to different lairs due to on-ice activities.

There is an ongoing UME for ice seals, including ringed seals. Elevated strandings have occurred in the Bering and Chukchi Seas since June 2018. As of November 17, 2021, 95 ringed seal strandings have occurred, which is well below the partial abundance estimate of 171,418 ringed seals in the Arctic stock. The take proposed for authorization here does not provide a concern for any of these populations when considered in the context of these UMEs, especially given that the anticipated Level B harassment is unlikely to affect the reproduction or survival of any individuals. In addition, the ICEX22 Study Area is in the Arctic Ocean, well north and east of the primary area where seals have stranded along the western coast of Alaska (see map of strandings at: *https://www.fisheries.noaa.gov/alaska/marine-life-distress/2018-2021-ice-seal-unusual-mortality-event-alaska*). No Level A harassment, serious injury, or mortality is expected or proposed for authorization here, and take by Level B harassment of ringed seals would be reduced to the level of least practicable adverse impact through the incorporation of mitigation measures. As such, the proposed takes by Level B harassment of ringed seals are not expected to exacerbate or compound the ongoing UME.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from this activity are not expected to adversely affect the species or stock through effects on annual rates of recruitment or survival:

- No Level A harassment (injury), serious injury, or mortality is anticipated or proposed for authorization;

- Impacts would be limited to Level B harassment, primarily in the form of behavioral disturbance that results in minor changes in behavior;
- TTS is expected to affect only a limited number of animals (approximately 0.5 percent of the partial stock abundance described in Table 1) and TTS is expected to be minor and short term;
- The number of takes proposed to be authorized are low relative to the estimated abundances of the affected stock;
- Submarine training and testing activities would occur over only four weeks of the total six-week activity period;
- There would be no loss or modification of ringed seal habitat and minimal, temporary impacts on prey;
- Physical impacts to ringed seal subnivean lairs would be avoided; and
- Mitigation requirements for ice camp activities would prevent impacts to ringed seals during the pupping season.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the proposed activity will have a negligible impact on the Arctic stock of ringed seals.

Unmitigable Adverse Impact Analysis and Determination

In order to issue an IHA, NMFS must find that the specified activity will not have an “unmitigable adverse impact” on the subsistence uses of the affected marine mammal species or stocks by Alaska Natives. NMFS has defined “unmitigable adverse impact” in 50 CFR 216.103 as an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

Impacts to marine mammals from the specified activity would mostly include limited, temporary behavioral disturbances of ringed seals; however, some TTS is also anticipated. No Level A harassment (injury), serious injury, or mortality of marine mammals is expected or proposed for authorization, and the activities are not expected to have any impacts on reproductive or survival rates of any marine mammal species.

The proposed specified activity and associated harassment of ringed seals are not expected to impact marine mammals in numbers or locations sufficient to reduce their availability for subsistence harvest given the short-term, temporary nature of the activities, and the distance offshore from known subsistence hunting areas. The specified activity would occur for a brief period of time outside of the primary subsistence hunting season, and though seals are harvested for subsistence uses off the North Slope of Alaska, the ICEX22 Study Area is seaward of subsistence hunting areas.

The Navy plans to provide advance public notice to local residents and other users of the Prudhoe Bay region of Navy activities and measures used to reduce impacts on resources. This includes notification to local Alaska Natives who hunt marine mammals for subsistence. If any Alaska Natives express concerns regarding project impacts to subsistence hunting of marine mammals, the Navy would further communicate with the concerned individuals or community. The Navy would provide project information and clarification of any mitigation measures that may reduce impacts to marine mammals.

Based on the description of the specified activity, and the proposed mitigation and monitoring measures, NMFS has preliminarily determined that there will not be an unmitigable adverse impact on subsistence uses from the Navy's proposed activities.

Endangered Species Act

Section 7(a)(2) of the Endangered Species Act of 1973 (ESA: 16 U.S.C. 1531 *et seq*.) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. To ensure ESA compliance for the issuance of IHAs, NMFS consults internally whenever we propose to authorize take for endangered or threatened species, in this case with NMFS' Alaska Regional Office (AKRO).

The NMFS Office of Protected Resources (OPR) is proposing to authorize take of ringed seals, which are listed under the ESA. The OPR has requested initiation of Section 7 consultation with the AKRO for the issuance of this IHA. NMFS will conclude the ESA consultation prior to reaching a determination regarding the proposed issuance of the authorization.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to the Navy for conducting submarine training and testing activities in the Arctic Ocean beginning in February 2022, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. A draft of the proposed IHA can be found at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-military-readiness-activities.*

Request for Public Comments

We request comment on our analyses, the proposed authorization, and any other aspect of this notice of proposed IHA for the proposed ICEX22 activities. We also request at this time comment on the potential Renewal of this proposed IHA as described in the paragraph below. Please include with your comments any supporting data or literature citations to help inform decisions on the request for this IHA or a subsequent Renewal IHA.

On a case-by-case basis, NMFS may issue a one-time, one-year Renewal IHA following notice to the public providing an additional 15 days for public comments when (1) up to another year of identical or nearly identical activities as described in the **Description of Proposed Activity** section of this notice is planned or (2) the activities as described in the **Description of Proposed Activity** section of this notice would not be completed by the time the IHA expires and a Renewal would allow for completion of the activities beyond that described in the *Dates and Duration* section of this notice, provided all of the following conditions are met:

● A request for renewal is received no later than 60 days prior to the needed Renewal IHA effective date (recognizing that the Renewal IHA expiration date cannot extend beyond one year from expiration of the initial IHA).

● The request for renewal must include the following:

(1) An explanation that the activities to be conducted under the requested Renewal IHA are identical to the activities analyzed under the initial IHA, are a subset of the activities, or include changes so minor (*e.g.*, reduction in pile size) that the changes do not affect the previous analyses, mitigation and monitoring requirements, or take estimates (with the exception of reducing the type or amount of take).

(2) A preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized.

● Upon review of the request for Renewal, the status of the affected species or stocks, and any other pertinent information, NMFS determines that there are no more than minor changes in the activities, the mitigation and monitoring measures will remain the same and appropriate, and the findings in the initial IHA remain valid.

Dated: December 7, 2021.

Kimberly Damon-Randall,

Director, Office of Protected Resources,

National Marine Fisheries Service.

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